1117-52-154 **Romanos Diogenes Malikiosis** (malikios@math.tu-berlin.de), **Sinai Robins*** (sinai_robins@brown.edu) and **Yichi Zhang** (yczhang@ntu.edu.sg). *Polyhedral Gauss sums, and polytopes with symmetry.*

We define certain natural finite sums of n'th roots of unity that are associated to each convex integer polytope P, and which generalize the classical 1-dimensional Gauss sum $G(n)$ defined over $\mathbb{Z}/n\mathbb{Z}$, to integer polytopes. We call these finite exponential sums which $G_P(n)$. It is therefore natural to ask: for which convex integer polytopes do we get closed forms for $G_P(n)$, analogous to the 1-dim'l Gauss case? We consider the finite Weyl group W, generated by the reflections with respect to the coordinate hyperplanes, as well as all permutations of the coordinates, and we let G be the group generated by W as well as all integer vector translations.

We prove that if P multi-tiles $\mathbb{R}^d$ under the action of the group G, then we have the closed form $G_P(n) = vol(P)G(n)$.

Conversely, we also prove that if the closed form expression $G_P(n) = vol(P)G(n)$ is true for $n \in \{1, 2, 3, 4\}$, and P is a lattice tetrahedron in $\mathbb{R}^3$ of (minimal) volume 1/6, then there is an element $g \in G$ such that $g(P)$ is the fundamental tetrahedron with vertices $(0, 0, 0), (1, 0, 0), (1, 1, 0)$, and $(1, 1, 1)$. We will mention lots of open questions that arise naturally. (Received January 12, 2016)